PCT/EP 99/01316

09/622658

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Patentanmeldung Nr. Patent application No. Demande de brevet n°

98103506.6

PRIORITY DOCUMENT

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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

Anmeldung Nr.:
Application no.: 98103506.6
Demande n°:

Anmeldetag:
Date of filing: 27/02/98
Date de dépôt:

Anmelder:
Applicant(s):
Demandeur(s):
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Bezeichnung der Erfindung:
Title of the invention:
Titre de l'invention:
Residential telecommunication system for wireless mobile telecommunication in the TDD-mode, particularly a universal mobile telecommunication system (UMTS) for the uncoordinated, unpaired, residential band

In Anspruch genommene Prioriät(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

Staat: State: Pays:	Tag: Date: Date:	Aktenzeichen: File no. Numéro de dépôt:

Internationale Patentklassifikation:
International Patent classification:
Classification internationale des brevets:
H04J3/00

Am Anmeldetag benannte Vertragstaaten:
Contracting states designated at date of filing: AT/BE/CH/CY/DE/DK/ES/FI/FR/GB/GR/IE/IT/LI/LU/MC/NL/PT/SE
Etats contractants désignés lors du depôt:

Bemerkungen:
Remarks:
Remarques:

Description

Residential telecommunication system for wireless mobile telecommunication in the TDD-mode, particularly a universal mobile telecommuncation system (UMTS) for the uncoordinated, unpaired, residential band

In communication systems comprising an information transmission link between an information source and an information sink, transmitting and receiving devices are used for information processing and transmission, in which devices

1) the information processing and information transmission can take place in a preferred direction of transmission (simplex mode) or in both directions of transmission (duplex mode),
2) the information processing is analog or digital,
3) the information transmission over the long-distance transmission link is wired or on the basis of different methods of information transmission FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access) and/or CDMA (Code Division Multiple Access) - e.g. according to various radio standards such as DECT, GSM, WACS or PACS, IS-54, IS-95, PHS, PDC etc. [compare IEEE Communications Magazine, January 1995, pages 50 to 57; D.D. Falconer et al: „Time Division Multiple Access Methods for Wireless Personal Communications"] wireless.

„Information" is a generic term which stands both for the intelligence (information) and for the physical representation (signal). Even if an information contains the same intelligence - i.e. has the same information content - different signal forms ca occur. Thus, for example, an information relating to an object can be transmitted

(1) in the form of an image,
(2) as a spoken word,
(3) as a written word,
(4) as a coded word or image.

In this connection, the type of transmission according to (1)...(3) is normally characterized by continuous (analog) signals whilst discontinuous signals (e.g. pulses, digital signals) are usually produced in the case of the type of transmission according to (4).

Based on this general definition of a communication system, the invention relates a residential telecommunication system for wireless mobile telecommunication in the TDD-mode, particularly a universal mobile telecommuncation system (UMTS) for the uncoordinated, unpaired residential band.

Telecommunication systems for wireless mobile telecommunication in the TDD-mode resp. FDD-mode, particularly universal mobile telecommuncation systems (UMTS) for the uncoordinated resp. coordinated band, shown and described in the printed documents **(1)**: *Nachrichtentechnik Elektronik, Berlin 45, 1995, part 1, pages 10 bis 14 und part 2, pages 24 bis 27; P.Jung, B.Steiner: „Konzept eines CDMA-Mobilfunksystems mit gemeinsamer Detektion für die dritte Mobilfunkgeneration"*; **(2)**: *Nachrichtentechnik Elektronik, Berlin 41, 1991, part 6, pages 223 bis 227 und page 234; P.W.Baier, P.Jung, A.Klein: „CDMA - ein günstiges Vielfachzugriffsverfahren für frequenzselektive und zeitvariante Mobilfunkkanäle"*; **(3)**: *IEICE Transactions on Fundamentals of Electonics, Communications and Computer Sciences, Vol. E79-A, No. 12, December 1996, pages 1930 bis 1937; P.W.Baier, P.Jung: „CDMA Myths and Realities Revisited"*; **(4)**: *IEEE Personal Communications, February 1995, pages 38 bis 47; A.Urie, M.Streeton, C.Mourot: „An Advanced TDMA Mobile Access System for UMTS"*; **(5)**: *telekom praxis, 5/1995, pages 9 bis 14; P.W.Baier: „Spread-Spectrum-Technik und CDMA - eine ursprünglich militärische Technik erobert den zivilen Bereich"*; **(6)**: *IEEE Personal Communications, February 1995, pages 48 bis 53; P.G.Andermo, L.M.Ewerbring: „An CDMA-Based Radio Access Design for UMTS"*; **(7)**: *ITG Fachberichte 124 (1993), Berlin, Offenbach: VDE Verlag ISBN 3-8007-1965-7,*

pages 67 bis 75; Dr. T.Zimmermann, Siemens AG: „Anwendung von CDMA in der Mobilkommunikation"; **(8)**: *telcom report 16, (1993), part 1, pages 38 bis 41; Dr. T. Ketseoglou, Siemens AG und Dr. T.Zimmermann, Siemens AG: „Effizienter Teilnehmerzugriff für die 3. Generation der Mobilkommunikation - Vielfachzugriffsverfahren CDMA macht Luftschnittstelle flexibler"*, are based on the multiple acces methods CDMA, FDMA and /or TDMA and called the radio telecommunication scenario of the third generation.

The radio telecommunication scenario of the second generation is shaped at the moment i.e. in the licensed pico-, micro-, and/or macro-cellular area of the GSM-specific telecommunication system, which is based on the FDMA/TDMA/FDD-principle of transmission (**F**requency **D**ivision **D**uplex) [**G**roupe **S**péciale **M**obile oder **G**lobal **S**ystem for **M**obile **C**ommunication; vgl. **(1)**: Informatik Spektrum 14 (1991) Juni, Nr. 3, Berlin, DE; A.Mann:"Der GSM-Standard - Grundlage für digitale europäische Mobilfunknetze", pages 137 bis 152; **(2)**: R.Steele: Mobile Radio Communications, Pentech Press, 1992 (Reprint 1994) , Chapter 8: The Pan-European Digital Cellular Mobile Radio System - known as GSM, pages 677 ff.; **(3)**: telekom praxis 4/1993, P. Smolka: „GSM-Funkschnittstelle - Elemente und Funktionen", pages 17 und 24] and in the unlicensed pico-cellular area of the DECT-specific telecommunication system, which is based on the FDMA/TDMA/TDD-principle of transmission (**T**ime **D**ivision **D**uplex) [**D**igital **E**nhanced (früher: **E**uropean) **C**ordless **T**elecommunication; vgl. **(1)**: Nachrichtentechnik Elektronik 42 (1992) Jan./Feb. Nr. 1, Berlin, DE; U. Pilger „Struktur des DECT-Standards", pages 23 bis 29 **in Verbindung mit** der ETSI-Publikation ETS 300175-1...9, Oktober 1992; **(2)**: telcom report 16 (1993), Nr. 1, J. H. Koch: „Digitaler Komfort für schnurlose Telekommunikation - DECT-Standard eröffnet neue Nutzungsgebiete", pages 26 und 27; **(3)**: tec 2/93 - Das technische Magazin von Ascom „Wege zur universellen mobilen Telekommunikation", pages 35 bis 42; **(4)**: Philips

Telecommunication Review Vol. 49, No. 3, Sept. 1991, R.J. Mulder:" DECT, a universal cordless access system"; **(5)**: WO 93/21719 (FIG 1 to 3 with the corresponding description)].

FIGURE 1 shows the TCH-multiframe-, TDMA-frame- and TDMA-timeslot-structure of the GSM-mobile radio concept, which is used for transmission of effective data on the traffic channel TCH and which is known from the prior art documents „*(1): Informatik Spektrum 14 (1991) Juni, Nr. 3, Berlin, DE; A.Mann:"Der GSM-Standard - Grundlage für digitale europäische Mobilfunknetze", pages 137 bis 152; (2): R.Steele: Mobile Radio Communications, Pentech Press, 1992 (Reprint 1994), Chapter 8: The Pan-European Digital Cellular Mobile Radio System - known as GSM, pages 677 ff.;* **(3)**: telekom praxis 4/1993, P. Smolka: „GSM-Funkschnittstelle - Elemente und Funktionen", pages 17 und 24". The data embedded in the shown structure are transmitted in the uplink (transmission „mobile station → base station") in the frequence band between 890 MHz and 915 MHz and in the downlink (transmission „base station → mobile station") in the frequence band between 935 MHz and 960 MHz regarding the FDD-principle.

FIGURE 2 shows the multiframe-, TDMA-frame- and TDMA-timeslot-structure of the DECT-mobile radio concept, which is known from the prior art documents „Nachrichtentechnik Elektronik 42 (1992) Jan./Feb. Nr. 1, Berlin, DE; U. Pilger „Struktur des DECT-Standards", pages 23 bis 29". The data embedded in the shown structure are transmitted in the downlink (transmission „base station → mobile station") in the timeslots 0...11 and in the uplink (transmission „mobile station → base station") in the timeslots 12...23 regarding the TDD-principle.

FIGURE 3 shows on the basis of the printed document *Nachrichtentechnik Elektronik, Berlin 45, 1995, part 1, pages 10 bis 14 und part 2, pages 24 bis 27; P.Jung, B.Steiner: „Konzept eines CDMA-Mobilfunksystems mit gemeinsamer*

Detektion für die dritte Mobilfunkgeneration" a possible FDMA/TDMA/CDMA-multiple access in the uplink (transmission direction „mobile station --> base station") and downlink (transmission direction „base station --> mobile station") of a telecommunication system with CDMA-,FDMA- und TDMA-multiple access elements, i.e. a Joint Detection-CDMA-mobile radio concept, at which the data are transmitted either - in comparison to the GSM-system (compare FIGURE 1) - in the uplink (transmission „mobile station → base station") and in the downlink (transmission „base station → mobile station") in different frequency bands regarding the FDD-principle or - in comparison to the DECT-system (compare FIGURE 2) in the uplink (transmission „mobile station → base station") and in the downlink (transmission „base station → mobile station") in the same frequency band regarding the TDD-principle.

The number of subscriber, which are active in one timeslot at the same time, is for example K = 8. The used bandwith B is between 1,2 and 1,6 MHz.

FIGURE 4 shows on the basis of the multiple access shown in FIGURE 3 the burst structure of the up link (transmission direction „mobile part --> base station") of the Joint Detection-CDMA-mobile radio concept, which is known, particularly from picture 5 of the prio art document *Nachrichtentechnik Elektronik, Berlin 45, 1995, part 1, pages 10 bis 14 und part 2, pages 24 bis 27; P.Jung, B.Steiner: „Konzept eines CDMA-Mobilfunksystems mit gemeinsamer Detektion für die dritte Mobilfunkgeneration*".

The 24 data symbols of the effective data blocks in FIGURE 4 contain each as „chip" formed data elements, which are spreaded with a subscriber-specific spreading code with a spreading factor of Q = 14.

The object forming the basis of the invention consists of a telecommunication system - i.e. mobile station, base station, network etc. - for wireless mobile telecommunication in the TDD-mode, particularly a universal mobile telecommuncation system (UMTS) for the uncoordinated, unpaired, residential band, which has an improved (i.e. safty) handover procedure after handover indication (setup and confirmation).

This object is achieved by the features specified in claims 1 and 2.

An embodiment of the invention will be explained in the following.

This draft proposes a TDD mode for the UTRA which is embedded in the W-CDMA concept, uses TD-CDMA techniques and DECT experience.
Also enclosed is a objective comparison of this proposal with DECT+, which will be the basis for a further decision analysis on which Radio access technique is the best for residential environment. The above mentioned decision analysis is not part of this proposal.

→→→ **WHAT ARE THE ADVANTAGES OF THIS PROPOSAL ?**

- TDD for inhouse systems uses same structure as TDD for asymmetric data cellular.
- Harmonisation with TDD Mode for asymmetric cellular data-services.
- Easy implementation of dual mode FDD/TDD terminals.
- Easy and fast implementation of a Dual Mode terminal, which provides GSM for outdoor use (offering speech and slow data services) and TD-CDMA for inhouse use (offering speech and fast packet data services).
- Terminal use for inhouse and outdoor.

1 ABBREVIATIONS

The following abbreviations will be used in this proposal:

AGCH Access Grant Channel
BCCH Broadcast Channel
DCS Dynamic Channel Selection
DRA Dynamic Resource Allocation
FACCH Fast Associated Control Channel
MS Mobile Station
PCH Paging Channel
QoS Quality of Service
RACH Random Access Channel
RF Radio Frequency, Radio Frequency part
RFT Radio Fixed Terminal - (comparable to a BTS in residential environment)
RSSI Radio Signal Strength Indicator
TCH Traffic Channel

2 Frame structure for Residential and Uncoordinated Band

2.1 TDMA Frame Structure

The frame structure for the uncoordinated TDD mode is shown below. It is principally the same as in the UMTS TD-CDMA TDD mode for cellular mobile communication. As in DECT, the switching point between downlink and uplink is fixed. It divides the frame into two equal parts, where the first 4 timeslots are dedicated to downlink and the second 4 timeslots are used for uplink transmission. The main reasons for the choice of a fixed switching point is that a simultaneous service to all subscribed MS has to be possible in an uncoordinated manner, therefore the uplink channel is needed with it's full capacity in contrast to a cellular mobile communications system, where the interference situation can be better controlled due to synchronised MSs.

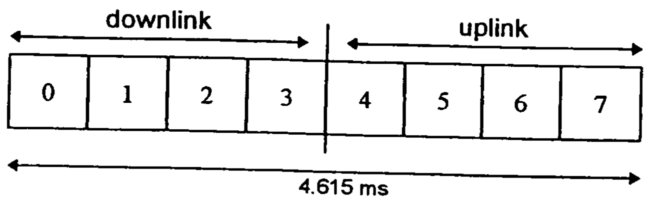


Fig. 1: TDMA frame structure; the first 4 timeslots are used for downlink, the second 4 timeslots are used for uplink transmission

2.2 TDD/TD-CDMA Frame Structure

The TDD/TD-CDMA frame structure is created in such a way that compatibility either to GSM or UMTS outdoor BSs is guaranteed. This is achieved by keeping the same multiframe structure as in GSM. In a 60ms period one idle frame is introduced which may be used for BCCH or PICH measurements and pre-synchronisation for handover preparation and DCS.

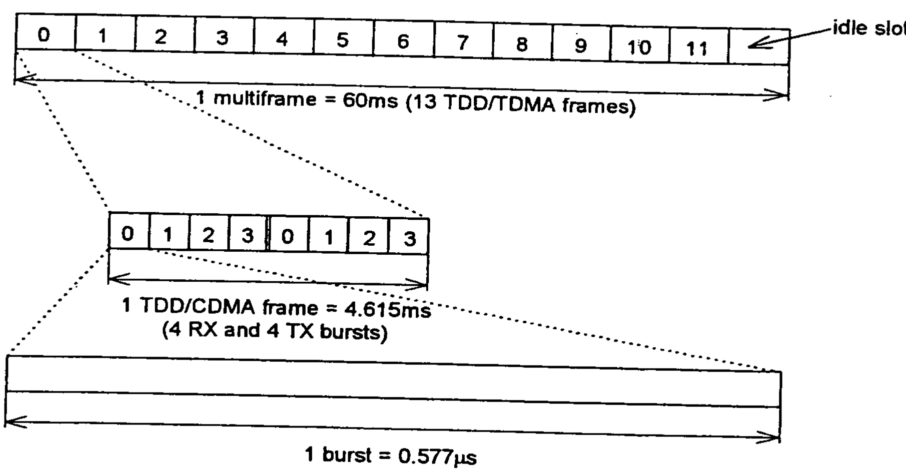


Fig. 2 TDD/TD-CDMA frame structure; 13 TDD/TD-CDMA frames form a 60ms lasting multiframe, where the 13th frame is idle. This idle frame can be used for measurements of the BCCH frequencies of surrounding GSM or UMTS BSs and for pre-synchronisation to these BSs for handover preparation and for DCS.

2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation

To allow an unlicensed private operation of UMTS based systems a special burst structure which is suited to the conditions of the uncoordinated environment has to be introduced. The burst structure proposed in Fig. 2 allows an uncoordinated operation due to the introduction of special fields which allow forward and backward sliding collision detection. The synchronisation field might include a synchronisation word and/or a midamble for channel estimation. Whether a channel estimator is necessary in residential environments needs to be further investigated.

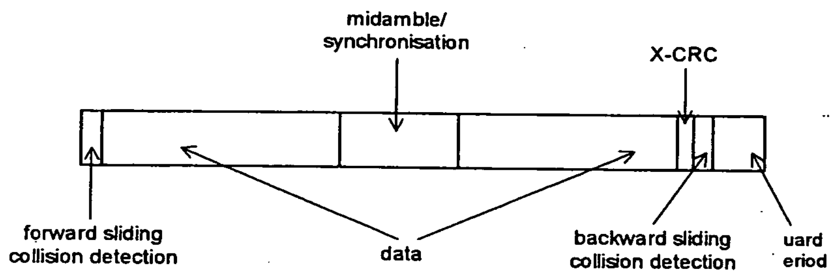


Fig. 3: Principle construction of a burst, which can be used for uncoordinated operation

3 Channel Allocation

3.1 Overview

The most significant difference between a cellular mobile communications system and a system that works in an uncoordinated unlicensed manner is the way how the physical resource "channel" is allocated to the user. In cellular mobile communications systems the channel allocation is controlled centrally by one instance, the network operator. This can be done due to the fact that all mobile stations within the coverage area of a base station use the same time base, i.e. all mobile stations operate synchronously. This allows a clear definition of timeslot boundaries and thereby a clear separation of different users. Neighbouring base stations do not have to be operated synchronously since the separation of channels used in neighbour-cells is generally

done in the frequency domain by frequency planning. This type of channel allocation is termed *Fixed Channel Allocation (FCA)*. However, in uncoordinated systems the allocation of channels can not be controlled by a single instance, implying the necessity of a *Dynamic Channel Selection (DCS)* capability. A well proved representative for such a system is DECT. DECT uses the frequency/time domain as "pool" for DCS and channel allocation. Therefore, a mobile station periodically scans the frequency/time domain and selects the frequency/timeslot-combination which gives the best transmission performance, i.e. the channel with the lowest interference. Due to the fact that other uncoordinated operated base and mobile stations operate asynchronously their time bases drift against each other, which inherently leads to a situation where the interference within the studied timeslot rises to in unacceptable level. In such a case a handover to another channel has to be initiated.

3.2 Channel usage

For Up- and Downlink, the RFT shall select a TDD pair, i.e. two timeslots using the same frequency, and starting points of the timeslots are separated by 0,5 frame.
To improve performance and spectral efficiency, the RFT may also select TDD-pairs, which timeslots are located on different frequencies and are not separated by a fixed amount of 0,5 frame. *(Editors note: This is very interesting and should be for further study, at the moment this mode is not considered since it may not work.)*
As shown in Fig. 4, the RFT shall select one single timeslot in the downlink time domain and shall bundle the required bearer services in the code domain. The MS's which are

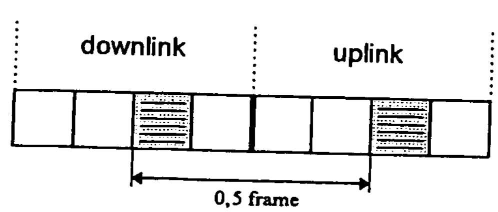


Fig. 4: TDD pair selection for duplex and simplex bearer

subscribed and synchronised to the appropriate RFT shall select the corresponding timeslot in the uplink time domain. The codes in the code domain per RFT are divided up as follows:

- 1 code for Signalling and AGCH
- 6 codes for Traffic channels (TCH)
- 1 code for Broadcast Channel (BCCH and PCH)

For the uplink domain, the codes are decided up as follows:

- 1 code for Random Access Channel (RACH)
- 1 code for Fast Access Channel to indicate handover (FACCH)
- 6 codes for uplink Traffic channels (TCH)

The RFT uses Dynamic Resource Allocation (DRA) to allocate the code domain within the downlink timeslot to the requested services. DRA is defined in subclause

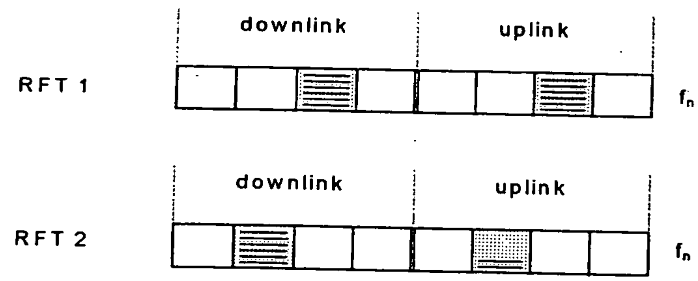


Fig. 5 RFT1 uses f_n , Slot 2 to serve 6 speech services to 6 MS's simultaneously RFT2 uses f_n, Slot 1 to serve 1 fast packet data service to MS 1 and speech service to MS 2 simultaneously, 5 data channels are bundled in the downlink domain to offer high seed data, in the uplink domain only one code is needed (typical Internet session).

Fig. 5 shows an example for channel usage

3.3 DYNAMIC CHANNEL SELECTION

The term "channel" refers to the relevant physical channel of one code of a TDD-pair. Since the RFT selects an appropriate timeslot, all needed channels are selected simultaneously.

Prior to the first transmission the RFT has to select a timeslot with the least interference and best quality.

Once this timeslot has been selected, it is only allowed to be changed due to a detected need to change it. Typical needs are detection of bad quality or interference on the timeslot in use, detection of a timeslot with less interference than the one in use and detection of local congestion.

3.3.1 Channel selection list

To find appropriate TDD-pairs for the dynamic channel selection, the TDD-pairs shall be ordered according to the measured field strength. The RFT shall measure the RSSI in the relevant timeslots to find the best available TDD-pair to support the best quality of service.

The resolution of the RSSI measurement shall be better than or equal to C100 dB. The lowest boundary shall be equal to or less than C101 dBm. TDD-pairs with a RSSI of each less than this lowest boundary shall be considered as quiet channels and may be immediately selected for BCCH setup. An upper limit may be defined where a channel is considered to be busy. The TDD-pairs with a RSSI value of more than this upper limit shall not be selected by the RFT. TDD-pairs with a measured field strength which lies between these two boundaries shall be ordered according to the timeslot with the higher field strength of the TDD-pair.

The RFT should select the quietest TDD-pair for BCCH setup.

The RFT shall continuously update the channel selection list to provide itself with best possible TDD-pairs, which may be used for handover. The complete modified channel list shall have been updated within the last T100 seconds.

3.3.2 Handover indication

In case of deterioration of QoS the RFT should initiate a handover of the actual services form the actual TDD-pair to a new TDD-pair. The RFT shall use the information available in the channel selection list for selection of a quiet TDD-pair which is expected to offer a better QoS.

There are two ways to indicate the need for handover:

Broadcast mode:

In the case that the RFT has no active traffic channel, only the RFT is transmitting the BCCH and there is no transmission from each MS. In this mode the RFT shall use the idle slot as defined in subclause „2.2 TDD/TD-CDMA Frame Structure" on page 8 to switch off it's own BCCH transmission and measure the field strength in it's own actual TDD-pair, i.e. measure the field strength in the actual used timeslots for uplink and downlink. The RFT shall use the measured results to update it's channel selection list and may use the measured results as an indication to handover.

To avoid heavy dynamic in handover activities, a threshold between the RSSI of the actual used TDD-pair and the quietest TDD-pair in the channel selection list is defined. The RFT shall not initiate a handover when the difference between the higher RSSI values of the actual TDD-pair and possible handover TDD-pair is less than C102 dB.

Traffic mode:

In the case that the RFT has setup at least one traffic channel, it is not possible to interrupt the actual channels for quality measurement. Here, three different handover indications may be used each or in combination to indicate the need for handover:

X-CRC Error control in the uplink path

For error control of the data a limited error detection scheme is always applied, 4 redundancy bits from selected data bits are calculated and transmitted in the X-CRC field, which occupies the last four bits in the data field, see subclause „2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation" .

A X-CRC error in the received data burst shall be treated by the RFT as indication for handover.

Sliding collision detection in the uplink path

As it can be seen from the burst structure in subclause „2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation", two fields are defined which surround the data field, these "sliding collision detection fields" consist of 4 Bits each, the MS is obliged to put the

contents of the X-CRC field also in these "sliding collision detection fields".

If the "forward sliding collision detection field" or the "backward sliding collision detection field" is not identical to the X-CRC field, this shall be treated by the RFT as indication for handover.

Signal strength measurements in the guard band

The RFT may take the guard periods which are defined in the burst structure in subclause „2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation", to measure the field strength in these periods and to take the results as indication for handover. The RFT is not obliged to do so.

X-CRC Error control in the downlink path

For error control of the data in the downlink path the same X-CRC error detection scheme is applied for the downlink burst as defined for the uplink burst. 4 redundancy bits from selected data bits are calculated and transmitted in the X-CRC field, which occupies the last four bits in the data field, see subclause „2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation".

A X-CRC error in the received data burst shall be treated by the MS as indication for handover, the MS shall use the "fast access channel" to send immediately a handover indication command to the RFT. The RFT shall treat this command as an indication for handover.

Sliding collision detection in the downlink path

For "sliding collision detection" the same scheme is applied for the MS as for the RFT, the RFT is obliged to put the contents of the calculated X-CRC field also in the "sliding collision detection fields" in it's downlink burst.

If the "forward sliding collision detection field" or the "backward sliding collision detection field" is not identical to the X-CRC field, this shall be treated by the MS as indication for handover, the MS shall use the

"fast access channel" to send immediately a handover indication command to the RFT. The RFT shall treat this command as an indication for handover.

Regarding the time-delay for handover indication, the following timing scheme shall be applied:

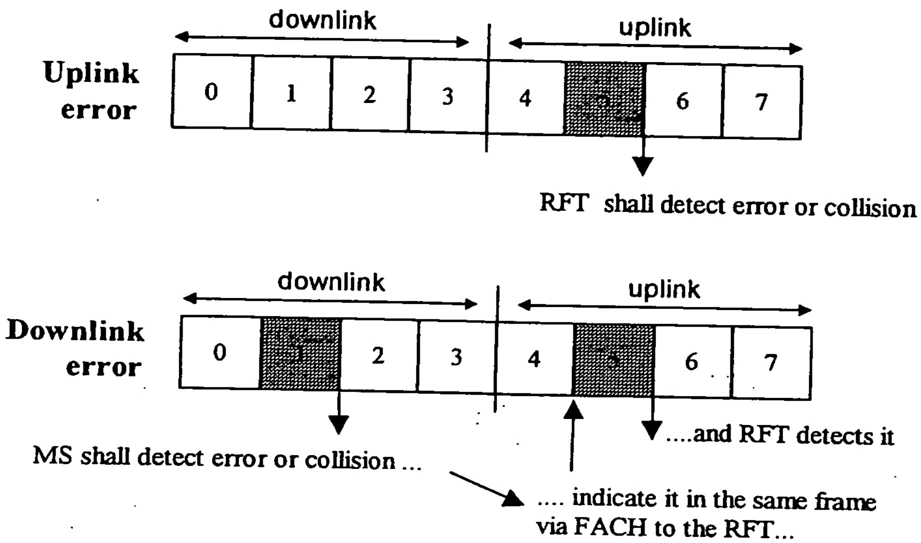


Fig. 6 Timing for handover indication, downlink and uplink

NOTE: Considering the scenario that a MS detects a handover indication, tries to indicate it to the RFT using the FACH but the FACH transmission fails due to some error conditions in the uplink domain, this is also solved because the RFT detects this error condition and initiates a handover anyhow.

4 HANDOVER PROCEDURE

After handover indication, the RFT should immediately initiate the handover procedure.

4.1 HANDOVER CANDIDATES

The following figure gives an overview of possible handover candidates in the channel selection list for a given TDD-pair, "-a-" indicates the active channel, "-ho-" indicates the handover candidates.

	Timeslot							
freq.	Downlink				uplink			
	0	1	2	3	4	5	6	7
0	–				–			
1	–				–			
2	–	–	–a–	–	–	–	–a	–
3	–				–			
4	–				–			
5	–				–			
6	–				–			
7	–				–			
8	–				–			
9	–				–			
10	–				–			

In the above example, it is not possible for the RFT to search for handover candidates in timeslot 2, the RFT may also search for handover candidates in slot 1 and slot 3, but in this case the RF part has to switch frequencies during the guard period which is defined in subclause „2.3 TDD/TD-CDMA Burst Structure for Uncoordinated Operation". This means costly RF parts, hence the RFT is not obliged to switch frequencies during the guard period, the RFT may also use a whole timeslot for frequency-switching.

4.2 Handover setup

After selection of handover timeslots the RFT shall setup the BCCH in the downlink timeslot of the selected handover TDD-pair. Also all data services which are sent on the original timeslot shall be sent simultaneously on the downlink timeslot of the selected handover TDD-pair.
After successful setup of the new BCCH the RFT shall immediately send a "handover request" command via the original BCCH to the attached MS's indicating the position of the new TDD-pair.
The RFT shall continue to send the actual data on both timeslots simultaneously and shall continue to send the "handover request" command vie the original BCCH until all served MS's confirm the handover procedure.

This procedure applies also to the broadcast mode which is defined in subclause „3.3.2 Handover indication", the only difference is that no additional data services are served simultaneously.

4.3 Handover confirmation

An attached MS which receives the "handover request" command from the RFT shall immediately change to the indicated handover channel. It shall stop transmitting on the old channel and shall seamless continue to send the data on the new channel. If the MS has no current data to transmit, it shall transmit the "handover confirm" command to the RFT. (*Editors note: further study has to be taken on the kind of signalling, which channel shall be used by MS's without current service and how does the handover procedure align with power saving concepts in the MS.*)
The RFT shall receive simultaneously the data on the old channels and the new channels. The handover shall be treated as confirmed for each MS, when the uplink data is received without errors on the new channel or the MS responds with a "handover confirm" command.
The completion of the handover is achieved when all MS's have confirmed the handover request. After completion of the handover transmission on the old channels shall be stopped.

5 Dynamic Resource allocation (DRA)

The RFT uses Dynamic Resource Allocation (DRA) to allocate the code domain within the downlink timeslot to the requested services. An example for DRA is shown in Fig. 5 on page 11 above.

After a MS obtained Access Request to the RFT, the RFT grants the Access Request and submits the codes for the dedicated channels to the MS. The RFT may assign one code for the dedicated service to the MS or all codes up to the full bandwidth.

Both the RFT and the MS may send a "service change request" command at any time to obtain more or less codes for a change

of the actual service. This request shall always be granted by the MS, it may or may not be granted by the RFT. The MS is always obliged to follow the service change commands of the RFT, since the RFT needs some codes for new services for another MS. The RFT may not be able to grant a service change request from a MS e.g. all codes are in use.
Every MS is guaranteed to be served by at least 1 code, it may be served by more than 1 code.
When the RFT has occupied the full bandwidth for a special fast packet data service to MS 1, and MS 2 requests one code for speech service, the RFT shall send a "service change request" to MS 1 to obtain one of the codes currently being in use for services to MS 1, after MS 1 grants this service change, the RFT is able to assign this code to the requested service of MS 2.

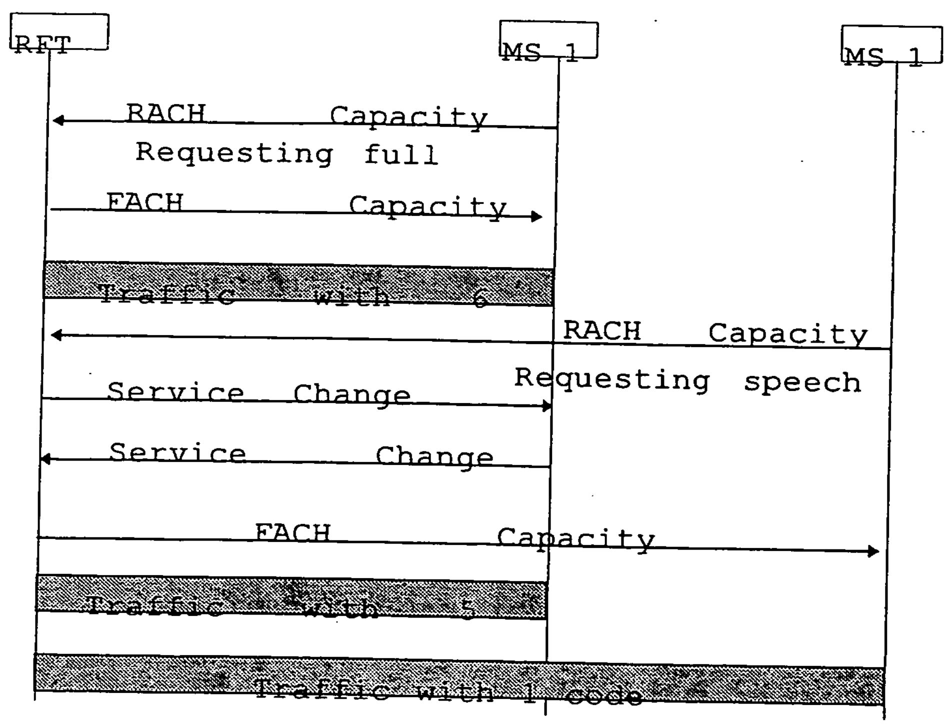


Fig. 7: Example scenario for DRA

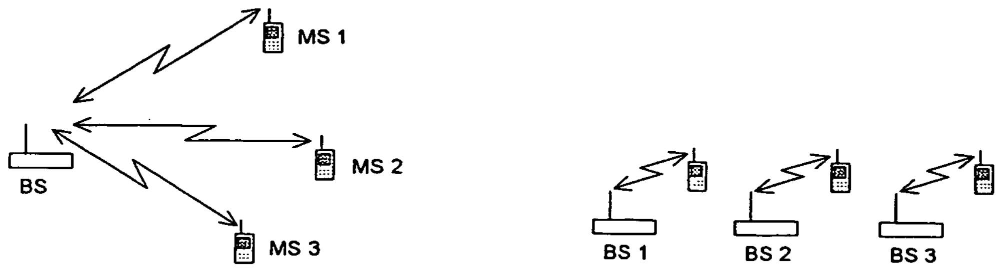
6 Brief Comparison of TDD/TD-CDMA and DECT+

In this subclause, a brief overview of DECT+ and TDD-TD/CDMA in the uncoordinated band is given. This subclause is not part of the proposal but only for information.

Feature	TDD - TD/CDMA	DECT+
Modulation scheme	QPSK or 16 QAM	$\pi/4$ D-QPSK
Carrier spacing	1.2 MHz - 1.6 MHz	1,728 MHz
No. of duplex channels per Carrier	32	12 (Fast Hopping) 6 (Slow Hopping)
Access technology	TDMA plus CDMA	TDMA
Gross bitrate per data channel	136 Bit / 577 µs = 235.7 kbit/s	640 Bit / 416.7µs = 1.536 Mbit/s
Effective bitrate per timeslot	136 Bit - 1088 Bit (DRA) per 4.615 ms = 29 kBit - 235 kBit	640 Bit per 10ms = 64kBit
no. of carriers within 20 MHz	12 (depends on the final carrier bandwidth)	10
no. of channels within 20 MHz	(codes * timeslots * carriers) 8 * 4 * 12 = 384	(timeslots * carriers) 12 * 10 = 120 (Fast Hopping) 6 * 10 = 60 (Slow Hopping)

Table 1: Comparison of TDD/TD-CDMA and DECT+

6.1 Interference in the Uncoordinated Residential Band



(a) (b)

Fig. 8 a) one base station serves several synchronous mobile stations which leads to a synchronous nature of interference

b) several uncoordinated base stations coexist implying an asynchronous type of interference

As it can be seen from the tables below, the probability for collision between uncoordinated base stations in the DECT-scenario is higher than in the TDD-TD/CDMA scenario since there are a lot of more conflicting points in the frequency-time domain.

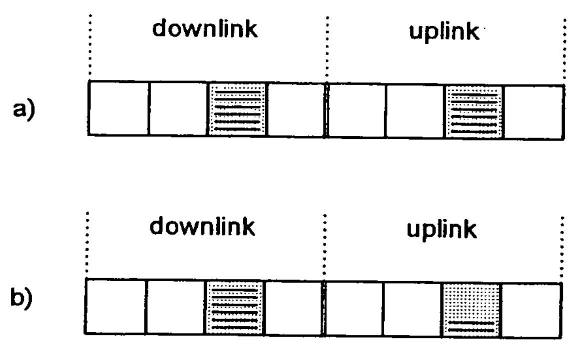


Fig. 9 a) 6 speech channels are bundled within one timeslot in the code domain

b) 5 data channels and 1 speech channel is bundled and kept within one timeslot to

provide asymmetric traffic more codes are used in downlink as in uplink direction

Concerning the interference produced by other users within the uncoordinated residential band one generally has to distinguish two different types of interference, this is interference produced by users which operate synchronised to a specific base station. A typical example for such a scenario is shown in Fig. 8a), where one base station serves

several mobile stations. This kind of interference can be well controlled by the base station. As well a separation of different users can be performed in the code domain using multiple user detection techniques as proposed in TD-CDMA. The other type of interference is produced by uncoordinated base and mobile stations, Fig. 8b). This type is characterised by its asynchronous nature. It can only be combated by means of dynamic channel allocation techniques as described in subclause 3 Channel Allocation. Fig. 10 and Fig. 11 describe the synchronous type of interference for both residential UMTS and DECT within a bandwidth of 20 MHz and its impact on the performance on DCS. In this example scenario the base station is serving 6 speech services to 6 different mobile stations simultaneously. It can easily be seen that in case a base station serves more than one mobile station TDD/TD-CDMA is capable of bundling the allocated channels to one timeslot rather than using physical channels spread in the whole frequency/time domain. This fact results in an overall performance improvement for the *dynamic channel selection (DCS)* algorithm since more timeslots are kept clear to be used by other uncoordinated base or mobile stations reducing the probability of collisions. The same applies to the situation where one user occupies more than one channel for high datarate applications. Fig. 5 shows a scenario where 5 channels are bundled together in downlink direction to provide a single user with a high datarate and simultaneously another user is served with speech service, all within one timeslot.

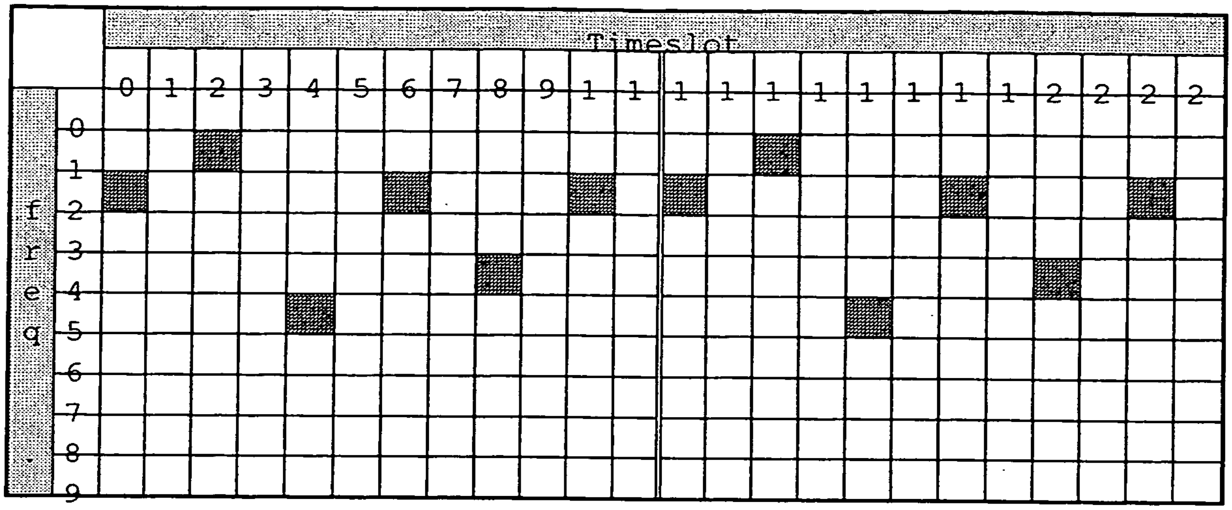


Fig. 10 Channel allocation in the frequency/time domain in DECT; different synchronous users served by one base station are allocated channels which are spread over the whole frequency/time domain increasing the probability of collisions with other uncoordinated users

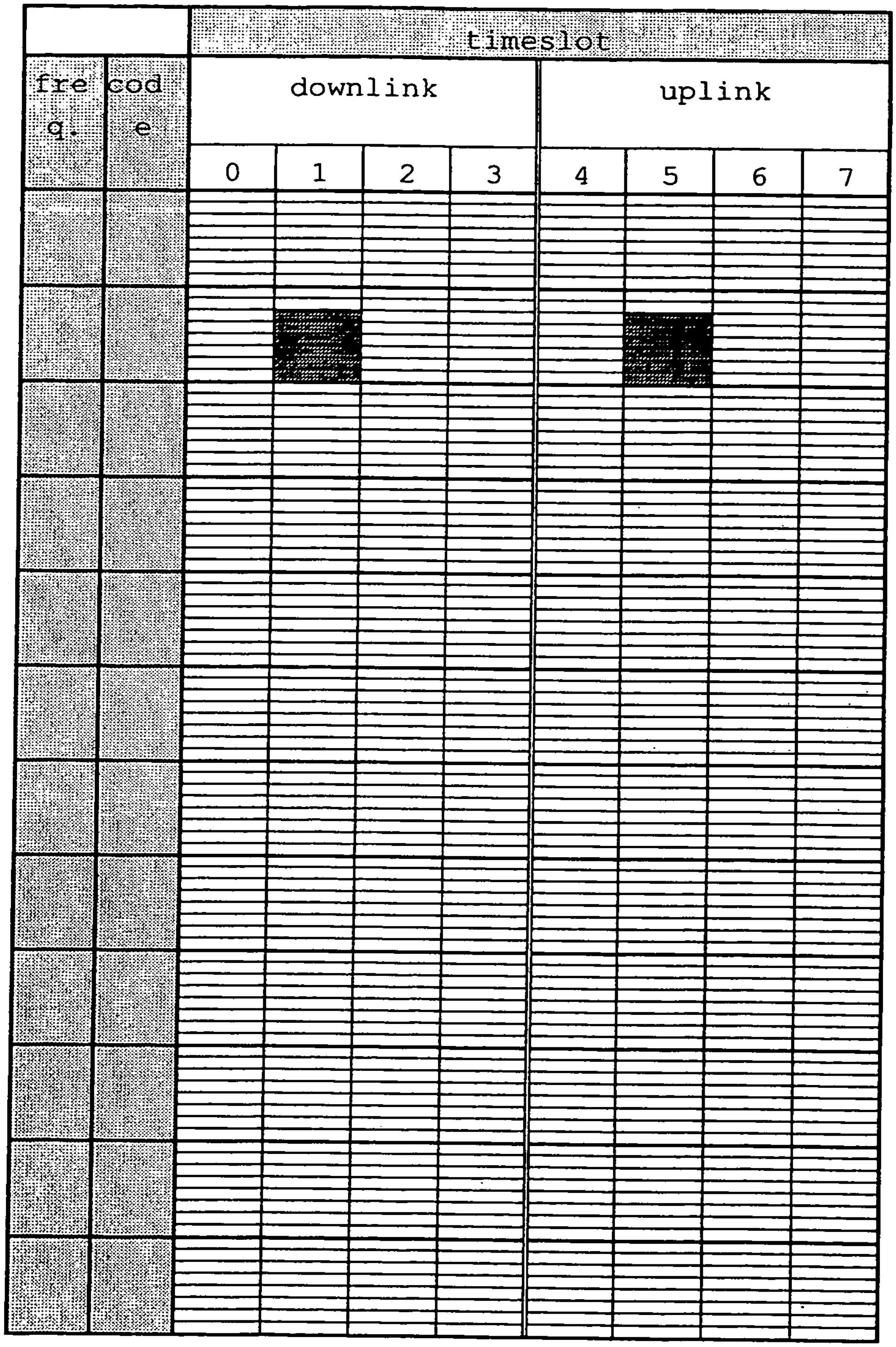
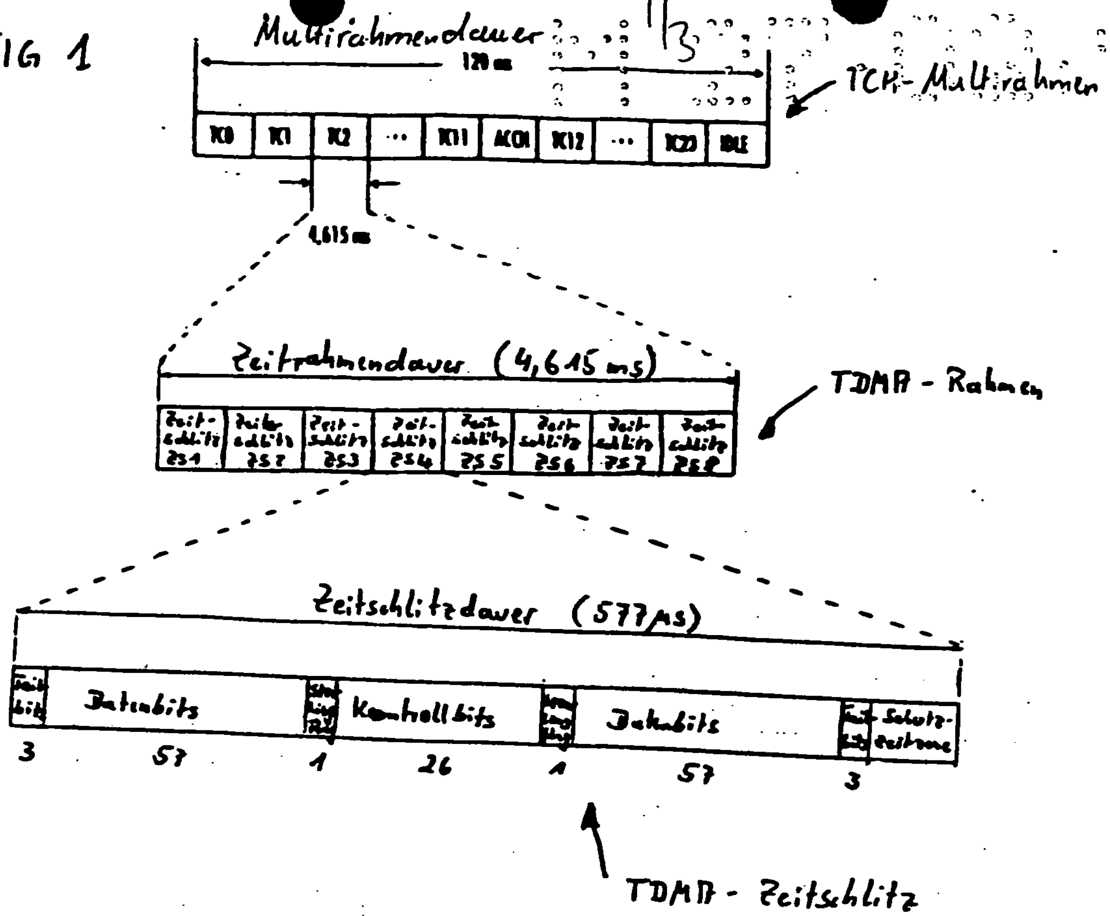


Fig. 11 Channel allocation in the frequency/time/code domain in TDD/TD-CDMA; different synchronous users served by one base station are allocated channels within one timeslot, due to the CDMA component in TD-CDMA a user separation in the code domain can be utilised efficiently

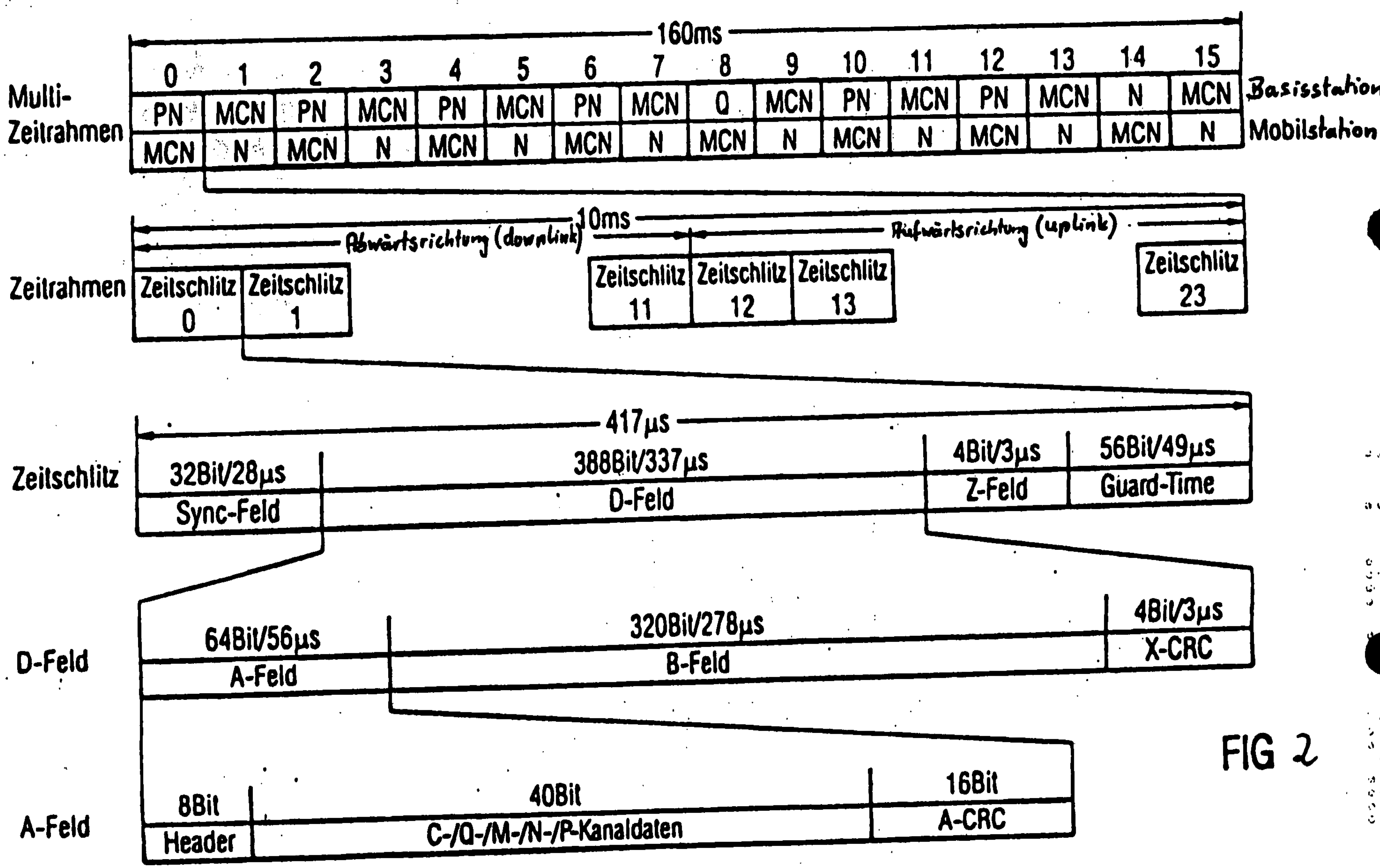
Claims

1. Telecommunication system for wireless mobile telecommunication in the TDD-mode, particularly a universal mobile telecommuncation system (UMTS) for the uncoordinated, unpaired, residential band comprising:
(a) carrier frequencies predetermined for the telecommunication system are divided each in a number of timeslots with in each case a predetermined timeslot duration in such a manner that the telecommunication system is be operable in the TDD-mode, whereby the timeslots per carrier frequency each form one TDMA-frame,
(b) at the most a predetermined number of unidirectional telecommunication links, uplinks or downlinks, between subscriber of the telecommunication system could be established simultaneously in the timeslots resp. within the frequency band of the telecommunication system, whereby for separating the subscriber signals transmitted in the course of this the subscriber signals are linked resp. combined with subscriber individual codes,
(c) in the TDD-mode a pair of timeslots of the TDMA-frame for the bidirectional telecommunication links, a first uplink-timeslot and a first downlink-timeslot, is selected in such a manner that the distance between the uplink-timeslot and the downlink-timeslot, which are assigned to the same carrier frequency or different carrier frequencies, is a fractional distance of the length of the TDMA-frame, whereby the distance is fixed or variable,
(e) when a handover is indicated and a handover pair of timeslots is selected the base station send a „handover request"-command to indicate the attached mobile stations the selected handover pair of timeslots on the original pair of timeslots - i.e. via the original BCCH - until all served mobile stations have confirmed the handover procedure.

FIG 1


Multirahmendauer
120 ms
TCH-Multirahmen
4,615 ms
Zeitrahmendauer (4,615 ms)
TDMA - Rahmen
Zeitschlitzdauer (577 µs)
Datenbits
Kontrollbits
Datenbits
Bits
3
57
1
26
1
57
3
TDMA - Zeitschlitz

2/3



Multi-Zeitrahmen
160ms
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
PN MCN PN MCN PN MCN PN MCN Q MCN PN MCN PN MCN N MCN
MCN N MCN N MCN N MCN N MCN N MCN N MCN N MCN N
Basisstation
Mobilstation
Zeitrahmen
10ms
Abwärtsrichtung (downlink)
Aufwärtsrichtung (uplink)
Zeitschlitz 0
Zeitschlitz 1
Zeitschlitz 11
Zeitschlitz 12
Zeitschlitz 13
Zeitschlitz 23
Zeitschlitz
417µs
32Bit/28µs
Sync-Feld
388Bit/337µs
D-Feld
4Bit/3µs
Z-Feld
56Bit/49µs
Guard-Time
D-Feld
64Bit/56µs
A-Feld
320Bit/278µs
B-Feld
4Bit/3µs
X-CRC
A-Feld
8Bit
Header
40Bit
C-/Q-/M-/N-/P-Kanaldaten
16Bit
A-CRC

FIG 2

FIG 3

3/3

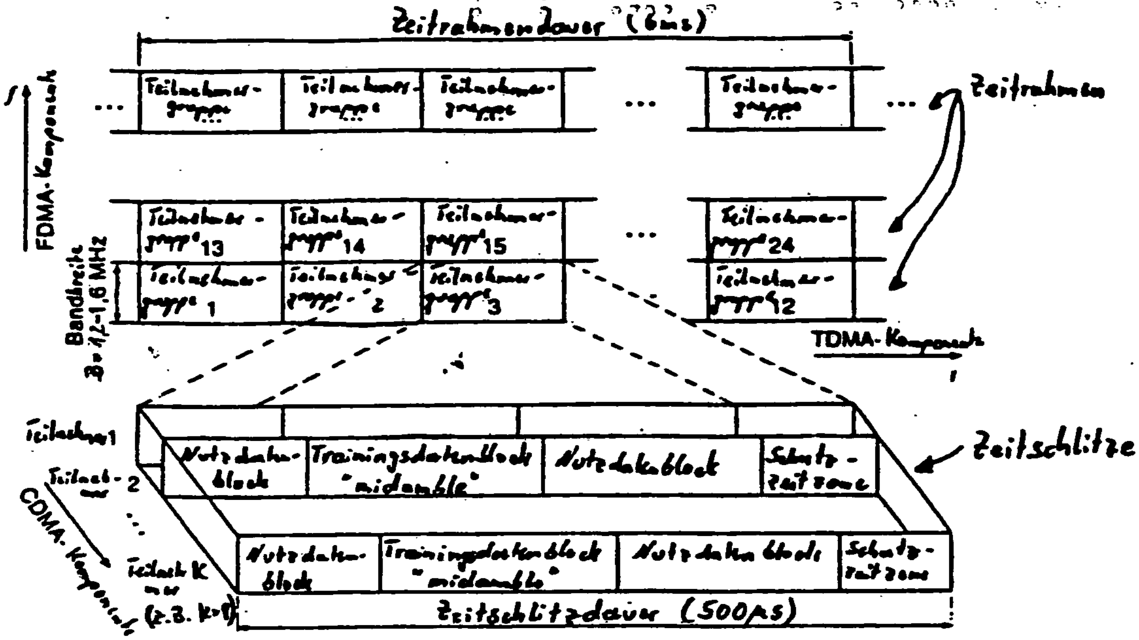
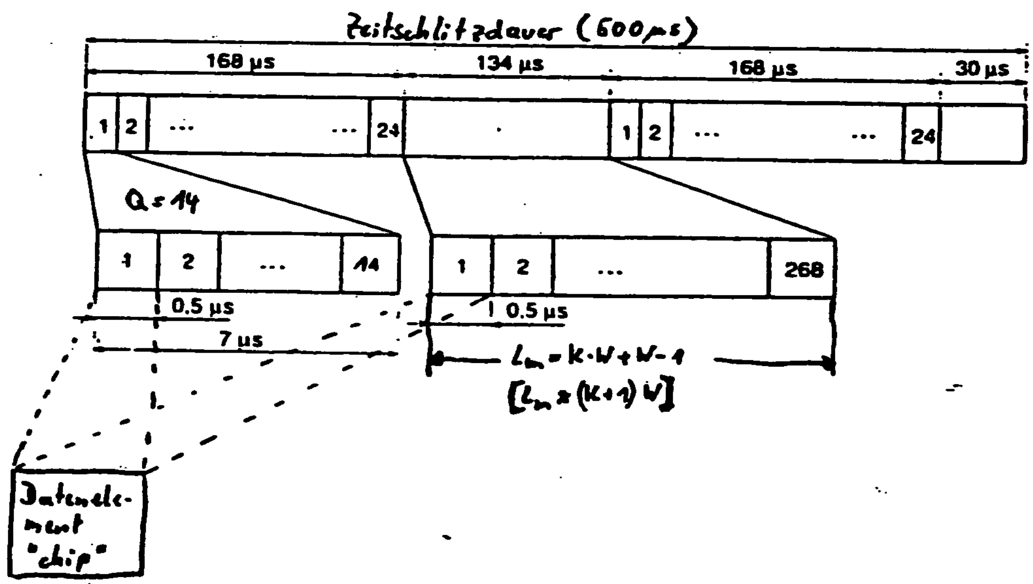

Zeitrahmendauer (6ms)
Zeitrahmen
FDMA-Komponente
Bandbreite B=1,2-1,6 MHz
Teilnehmergruppe 1
Teilnehmergruppe 2
Teilnehmergruppe 3
Teilnehmergruppe 12
Teilnehmergruppe 13
Teilnehmergruppe 14
Teilnehmergruppe 15
Teilnehmergruppe 24
TDMA-Komponente
Zeitschlitze
Teilnehmer 1
Teilnehmer 2
Teilnehmer K (z.B. K=7)
CDMA-Komponente
Nutzdatenblock
Trainingsdatenblock "midamble"
Schutzzeitzone
Zeitschlitzdauer (500µs)

FIG 4


Zeitschlitzdauer (500µs)
168 µs
134 µs
168 µs
30 µs
Q=14
0.5 µs
7 µs
268
$L_m = K \cdot W + W - 1$
$[L_m \approx (K+1) W]$
Datenelement "chip"